COURSE OVERVIEW EE0120
Power Generation
GAS TURBINES, STEAM POWER PLANTS, CO-GENERATION AND COMBINED CYCLE PLANTS
Selection, Applications, Operation, Maintenance and Economics

Course Title

Power Generation: GAS TURBINES, STEAM POWER PLANTS, CO-GENERATION AND COMBINED CYCLE PLANTS: *Selection, Applications, Operation, Maintenance and Economics*

Course Date/Venue

Session 1: February 09-13, 2025/Al Khobar Meeting Room, Hilton Garden Inn, Al Khobar, KSA

Session 2: October 19-23, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Reference

EE0120

Course Duration/Credits

Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

This course is designed to provide a thorough understanding of Steam Power Plants, Gas Turbines, co-generation and combined cycle plants. Each of the components such as compressors, gas and steam turbines, heat recovery steam generators, deaerators, condensers, lubricating systems, transformers and generators are covered in detail. The selection considerations, operation, maintenance and economics of co-generation plants and combined cycles as well as emission limits, monitoring and governing systems will also be covered thoroughly. All the significant improvements that were made to co-generation and combined cycles plants during the last two decades will also be explained.

Upon the successful completion of this course, each participant will have a comprehensive understanding of combined cycle, co-generation, Steam and Gas Turbine plants as well as their selection criteria, operation and maintenance requirements, and economics.

The course includes an e-book entitled"*Power Generation Technologies"*, published by Newnes, which will be given to the participants to help them appreciate the principles presented in the course.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply and gain an in-depth knowledge on power generation
- Explain steam power plants and steam turbines and auxiliaries
- Discuss gas turbines as well as current and future gas turbine technologies
- Distinguish the concepts of combined cycles and the turbine governing system
- Identify gas turbine instrumentation and control systems
- Discuss gas turbine emission guidelines and control methods including lubrication and fuel systems
- Review the economics of power generation, co-generation and combined-cycle plants
- Illustrate the applications of co-generation and combined-cycle plants
- Define transformers and explain interconnection with grid and transformer components
- Illustrate synchronous generators and generator operation
- Discuss generator components, generator excitation, AVR and PSS
- Employ generator operation, testing, inspection and maintenance

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course is essential for all technical staff who are working in power generation, utilities, process and other heavy industries. This includes fresh-graduate engineers, under-development engineers and engineers who have limited experience in power generation. Further, this course is suitable for all experienced technical personnel in power generation field who have no engineering degrees or formal training in engineering. Managers and engineers of different disciplines might find this course very useful as an awareness course in power generation.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Professor Mike Kanova is a **Senior Electrical** & **Instrumentation Engineer** with **over 35 years** of industrial experience within the **Oil & Gas**, **Petrochemical** and **Refinery** industries. His expertise extends widely over the areas of **Refining & Rotating Equipment, Process Equipment**, **Instrumentation & Control**, **Control Loop** Parameters, Control Loop Tuning, **Surge Protect**-Control, Business Management System **(BMS)**, **E&D Values** & **ROIVs** Partial Stroke Testify, **Alarm & Safety Interlocks** System, **P&IDs**, **Uninterruptible Power Supply** (**UPS**) Design & Maintenance, **UPS Construction**, **UPS DC & AC** Types & Application, **Static & Dynamic UPS**, **UPS Installation** Methods, **UPS Protection**, **Electric Heat Trace Syste**m, Foundation **Fieldbus Data Communication & Fieldbus Systems**, Data **Communication & Fieldbus** Systems, **Fiber Optics Access Network** Planning, **Overhead Power Line** Construction, **Power Systems** Control & Stability, **Fault Analysis** in Electrical Networks, OLE for Process Control (**OPC**), **Process Control & Instrumentation**, **Distribution Cables**, **Custody Measurement**, Loss **Control & Multiphase Flowmetering** of Petroleum Products, General **Instrumentation & Process Control** for Industrial Applications, **Process Instrumentation**, **Process Control & Instrumentation**, **Process Measurement & Control**, **Experion PKS** Operator, **SCADA** Systems, **Generator Excitation**, **Process Control** Techniques, Programmable Logic Controllers (**PLC**) Operation & Maintenance, **Allen Bradley PLC**, **Siemens SIMATIC S7** Maintenance & Configuration, Distributed Control System (**DCS**) Applications, Selection & Troubleshooting, **Compressor** Control & Protection, **GE Mark V**, **Power Systems** Control & Stability, Advanced **Electrical Safety**, **Switchgear** Maintenance & Troubleshooting, Electrical Fault Investigation, **Power System Planning & Economics**, **Distribution System**, **Electrical Networks & Power Flow Analysis**, **Electrical Power Distribution System** Performance & Methods of Improvement, Practical **Fiber Optics** Technology, Electric **Motor** Testing & Troubleshooting, Fundamentals of **Telecommunication**, Synchronous Digital Hierarchy (**SDH**) & Dense Wavelength Division Multiplexing (**DWDM**), **WiMax Broadband Wireless**, **SDH Networks**, **IPT Avaya Network**, **WAN & Satellite** Communication, **Wireless** Technology RC-400, National Electrical Code (**NEC**), National Electrical Safety Code (**NESC**), **Security Systems** Installation & Maintenance, **Protection Relay**, **Power Generation**, **Circuit Breakers & Switchgears** and **Gas Turbine**. Further, his experience has proven him well in the practice and has given him the chance to work with **international organizations** such as the Instrument Society of America (**ISA**), the Institute of Measurements and Control, the **United** Nations Educational Scientific and Cultural Organization (**UNESCO**) and the International Electrical Testing Association (**NETA**).

During Professor Kanova's career life, he gained extensive experience in the electrical, instrumentation and control systems engineering field through various challenging **engineering** & **managerial** positions that he filled while working as the **Scientist/Inventor**, **Project Manager**, **Development Engineer**, **Electronics Engineer**, **Stream Leader**, **Co-leader**, **Supervisor**, **Researcher**, **Conference Organizer**, **External Examiner**, **Lecturer** in Electronics, Opto-electronics and Power Electronics, **Course Developer**, **Organizing & Editorial Committee Member**, Part-time **Consultant** and Part-time **Lecturer** from the Cape Peninsula University of Technology, University of Cape Town, University of Western, University of Johannesburg Witwatersrand, Walter Sisulu University, **ESKOM**, NRF, SCINAC Tokai, Plessey Southern Africa Retreat, **Peninsula Technikon**, SA Nylon Spinners and R&B Electronics Rondebosch.

With the knowledge and skills he gained herein, he has produced **over 100 publications** and **papers** that were presented to numerous gatherings like the **International Conference on System Modelling & Control**; **International Conference on Industrial and Commercial Use of Energy**; **International Conference of Control Signals and Systems**; the **UICEE Annual Conference on Engineering Education**, the **ETMSA** (**Energy Technology Modelling**, **Simulation and Applications**), the **Symposium on Energy Technology**, **Modelling**, **Simulation & Applications**. Those papers were also published in journals such as the **NETA Journal**; the **IEEE Aerospace and Electronic Systems Journal**; the **International Journal of Power and Energy Systems**; the **Journal of the Electricity Supply Industry**; the **International Journal of Computers and Applications**; the **Journal of the Electronics Technology** and the **Quantum Journal**.

Professor Kanova is a **Registered Professional Engineer** and has a **PhD**, **Master** and **Bachelor** degrees in **Electrical Engineering**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/ Assessor/Trainer** by the **Institute of Leadership and Management** (**ILM**) and a well-respected member of the **IEEE** and is actively engaged with numerous projects in affiliation with the **Society for Photo-optical Instrumentation** Engineers (**SPIE**), the **Aerospace and Electronic Systems Society** (**AESS-IEEE**), the **Circuits and Systems Society** (**CSS-IEEE**), the **Lasers and Electro-optics Society** (**LES- IEEE**) and the **Power Electronic Society** (**PELS-IEEE**). He has further delivered numerous trainings, seminars, courses, workshops and conferences internationally.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Review of Thermodynamics Principles*** *First Law ● Saturated & Superheated Steam ● Second Law ● Carnot Cycle*
0930 – 0945	*Break*
0945 – 1115	***Steam Power Plants*** *Rankine Cycle, Economizers, Boilers, Superheaters, Reheaters, Moisture Separators, Condensers, Deaerators, Regeneration, Pumps, Cooling Water System, Ejectors*
1115 – 1230	***Steam Power Plants (cont'd)*** *Supercritical Plants, ● Co-Generation, Topping and Bottoming Cycles, Arrangements of Co-generation Plants, Economics of Co-generation*
1230 – 1245	*Break*
1245 – 1420	***Steam Turbines & Auxiliaries*** *Turbine Components and Energy Extraction Mechanisms, Turbine Types, Steam Extraction, Turning Gear, Jacking Oil System, Gland Seal, Lubrication System, Journal Bearings, Thrust Bearings, Hydraulic Control Systems*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Gas Turbines*** *The Simple Gas Turbine Cycle, Gas Turbine Types, Brayton Cycle, The Nonideal Brayton Cycle, Gas Turbine Performance Characteristics, Cycle Improvement, Gas Turbine Operation, Components of a Gas Turbine Power Plant, Gas Turbine Applications, Gas Turbines Versus Other Prime Movers*
0930 – 0945	*Break*
0945 – 1045	***Current & Future Gas Turbine Technologies*** *Non-Mast Technologies, MAST Technologies*
1045 – 1230	***Combined Cycles*** *Modifications of the Brayton Cycle, Regeneration, Compressor Intercooling, Turbine Reheat, Water Injection ● Design for High Temperature, Materials, Cooling ● Combined Cycles, Combined Cycles with Heat-recovery Boiler, Combined Cycles with Multi-Pressure Steam*
1230 – 1245	*Break*
1245 – 1420	***Combined Cycles Concepts*** *Basic Concepts ● Single-Pressure Cycle ● Dual-Pressure Cycle ● Reheat Cycles ● Cycles with Supplementary Firing ● Cycle Performance*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0815	***The Turbine Governing System*** *Functions ● Major Components ● Turbine Operation, Speed Control, Governing System Operation ● Turbine Run Up, Turbine Trip, Load Rejection, Decrease in Boiler Pressure, Hydraulic Liquid ● Tripping Signals for Steam Power Plants, Tripping Signals for Gas Turbines*
0815 – 0930	***Gas Turbine Instrumentation & Control Systems*** *Vibration Measurement, Pressure Measurement, Temperature Measurement ● Control System, , Speed Controller, Temperature Controller, Protection System, Startup and Shutdown Sequences*
0930 – 0945	*Break*
0945 – 1015	***Gas Turbine Emission Guidelines & Control Methods*** *Composition of Fuels, ● Emissions from Gas Turbines ● NOx Emission Target Levels ● NOx Emission Control Methods, Water and Steam Injection, Selective Catalytic Reduction (SCR), Dry Low NOx Combustors*
1015 – 1045	***Gas Turbines Lubrication & Fuel Systems*** *Lubricating Systems, Cold Start ● Fuel Systems, Water and Sediment, Carbon Residue ● Metallic Constituents and Sulphur ● Gas Fuel Systems ● Gas Turbine Starting, Intake and Exhaust Systems*
1045 – 1145	***Economics of Power Generation*** *Principles of Power Plant Design ● Location of Power Plant ● Cost Analysis ● Selection of Type of Generation ● Selection of Power Plant Equipment ● Economics in Plant Selection ● Factors Affecting the Economics of Power Generation ● Power Plant – Useful Life ● Performance and Operating Characteristics of Power Plants ● Economic Load Sharing*

1145 – 1230	***Economics of Co-Generation & Combined-Cycle Plants*** *Co-Generation Steam Considerations ● Co-Generation Application Considerations ● Combined Cycle Selection and Economics ● Economic Considerations for Performance Enhancement*
1230 – 1245	*Break*
1245 – 1420	***Applications of Co-Generation & Combined-Cycle Plants*** *Justification ● Applications, Re-Powering, Process Plants*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

0730 – 0930	***Transformers*** *Importance, Types and Construction ● Operation & Losses ● Impedance Transformation ● Circuits, Power Transmission and Losses ● Magnetizing Current*
0930 – 0945	*Break*
0915 – 1045	***Interconnection with Grid & Transformer Components*** *Interconnection with the Grid, Power Distribution, Main Output Transformers, Unit Service Transformers, Station Service Transformers ● Transformer Classifications and Ratings, Cooling Methods ● Main Components of a Power Transformer, Gas Detector Relays, Transformer Oil Characteristics ● Transformer Tap Changers*
1045 – 1230	***Synchronous Generators*** *Construction, Speed ● Excitation Methods ● Internal Generated Voltage ● Equivalent Circuit, Phasor Diagram, Power and Torque*
1230 – 1245	*Break*
1245 – 1420	***Synchronous Generator Operation*** *Operating Alone ● Parallel Operation ● Frequency-Power and Voltage-Reactive Power Characteristics ● Operation of Generators in Parallel with Large Power Systems ● Ratings (Voltage, Speed and Frequency) ● Capability Curves*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

Day 5

0730 – 0900	***Generator Components*** *Rotor ● Stator ● Seals*
0930 – 0945	*Break*
0915 – 1045	***Generator Excitation, AVR and PSS*** *Generator Excitation ● Automatic Voltage Regulator (AVR) ● Power System Stabiliser (PSS)*
1045 – 1230	***Generator Operation, Testing, Inspection & Maintenance*** *Operation ● Testing ● Inspection ● Maintenance ● Repairs*
1230 – 1245	*Break*
1245 – 1345	***Summary, Open Forum & Closing***
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-

Course Coordinator

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